ABSTRACT

A method for analog representation of the amplitudes of a vector in which a set of single-stranded nucleic acid oligomers E_i and $\underline{E}_i$ represents each m-component vector $\boldsymbol{V} = \Sigma_i V_i \boldsymbol{e}_i$, where E_i and $\underline{E}_i$ are each in 1:1 correspondence with the basis vectors $\boldsymbol{e}_i$, i=1,2,...,m in an abstract m-dimensional vector space. The E_i and $\underline{E}_i$ oligomers have complementary sequences, and represent the i-th component of $\boldsymbol{V}$ for which the amplitude V_i is positive and negative, respectively. The concentration of each of the oligomers E_i or $\underline{E}_i$ is proportional to the magnitude of the amplitude V_i of the i-th component of $\boldsymbol{V}$. The oligomers independently comprise subunits selected from the group consisting of deoxyribonucleotides, ribonucleotides, and analogs of deoxyribonucleotides or ribonucleotides, and any single oligomer can comprise one, or a combination of two or more, of said different types of subunits. The invention also includes methods for analog representation of the operations of vector addition and vector and matrix algebra that are implemented using vectors that are represented by sets of oligomers E_i and $\underline{E}_i$ as described above. The invention further includes a method for implementing an analog neural network, for which the data of each neuronal unit is represented by a set of oligomers E_i and $\underline{E}_i$ as described above; and interconnections and signaling between neuronal units are represented by sets of biochemical reactions that are analog representations of operations of vector and matrix algebra as described above. Application of a saturating function to a signal from one or more neuronal units to produce an output is represented by hybridizing a set of oligomers selected by such a set of biochemical reactions to a complete, sub-stoichiometric set of single-stranded E_i and $\underline{E}_i$ oligomers, and an output of the neural network is represented by a set of oligomers that specifically hybridize to such a sub-stoichiometric set of E_i and $\underline{E}_i$ oligomers.